AD-A105 734 NEW YORK STATE DEPT OF ENVIRONMENTAL CONSERVATION ALBANY F/G 13/13
NATIONAL DAM SAFETY PROGRAM. COLD SPRING DAM (UPPER) (INVENTORY--ETC(U)
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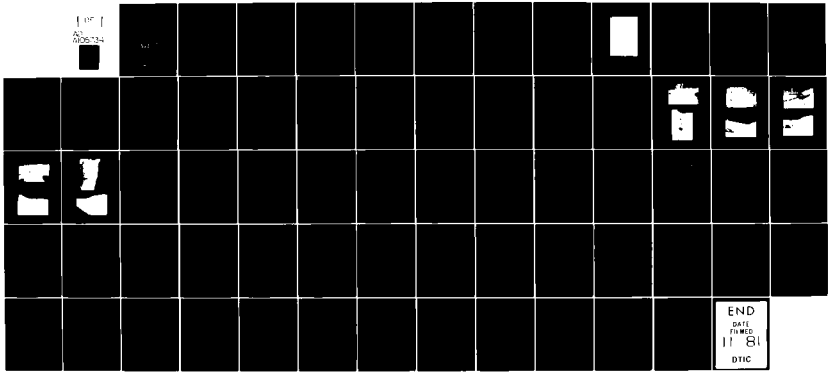

LEVEL II

8

LOWER HUDSON RIVER BASIN

COLD SPRING DAM (UPPER)

PUTNAM COUNTY, NEW YORK

INVENTORY NO. N.Y. 106

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM.

Cold Spring Dam (Upper) (Inventory Number N.Y. 106), Lower Hudson River Basin, Putnam County, New York. Phase I Inspection Report,

15 DACW51-79-C-0001

10 George Koch

NEW YORK DISTRICT CORPS OF ENGINEERS

11 JUN 81

12 66

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
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4. TITLE (and Subtitle) Phase I Inspection Report Cold Spring Dam (Upper) Lower Hudson River Basin, Putnam County, N.Y. Inventory No. 106	5. TYPE OF REPORT & PERIOD COVERED Phase I Inspection Report National Dam Safety Program 6. PERFORMING ORG. REPORT NUMBER
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Cold Spring Dam (Upper)
Putnam County
Lower Hudson River Basin

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report provides information and analysis on the physical condition of the dam at the report date. Information and analysis are based on visual inspection of the dam by the performing organization.

Visual inspection of this dam did not reveal conditions which constitute an immediate hazard to human life or property. However, the dam has some deficiencies which require further engineering investigations.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

Structural stability analyses performed for this report indicate that the factors of safety are below recommended values for all conditions studied. Safety factors fall to critical levels when the dam is subjected to severe loading conditions (such as flood flows or ice loading).

Using the Corps of Engineer's Screening Criteria for the review of spillway adequacy, it has been determined that the dam will be overtopped by all storms exceeding 23% of the Probable Maximum Flood (PMF). Stability analyses indicate that the dam would be unstable if subjected to the depth of overtopping which would result from one-half of the PMF. Since an overtopping induced failure would significantly increase the hazard to loss of life downstream of the dam, the spillway capacity is adjudged as "seriously inadequate" and the dam is assessed as "unsafe,non-emergency."

Immediately upon receipt of this notification, a system for providing around-the-clock surveillance of the dam during periods of unusually heavy precipitation should be developed. An emergency action plan for the notification of downstream residents should also be developed.

Within 3 months of the date of notification of the owner, investigations into the deficiencies on this structure should be commenced. Studies of the structural stability including subsurface investigations are necessary. Information obtained should be incorporated into a detailed stability evaluation. Additional hydrologic/hydraulic investigations are also needed to find a method to correct the spillway inadequacy. These studies should be performed in conjunction with the stability analysis to determine the proper mitigating measures needed in response to the seriously inadequate spillway assessment. Remedial measures deemed necessary as a result of these investigations should be completed within 18 months.

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
COLD SPRING DAM (UPPER)
I.D.NO. NY-106
LOWER HUDSON RIVER BASIN
PUTNAM COUNTY, NY

TABLE OF CONTENTS

Phase I Inspection Report
National Dam Safety Program

Name of Dam:	Cold Spring Dam (Upper) (I.D. No. NY-106)
State Located:	New York
County:	Putnam
Watershed:	Lower Hudson River Basin
Stream:	Foundry Brook
Date of Inspection:	April 22, 1981

ASSESSMENT

Visual inspection of this dam did not reveal conditions which constitute an immediate hazard to human life or property. However, the dam has some deficiencies which require further engineering investigations.

Structural stability analyses performed for this report indicate that the factors of safety are below recommended values for all conditions studied. Safety factors fall to critical levels when the dam is subjected to severe loading conditions (such as flood flows or ice loading).

Using the Corps of Engineer's Screening Criteria for the review of spillway adequacy, it has been determined that the dam will be overtopped by all storms exceeding 23% of the Probable Maximum Flood (PMF). Stability analyses indicate that the dam would be unstable if subjected to the depth of overtopping which would result from one-half of the PMF. Since an overtopping induced failure would significantly increase the hazard to loss of life downstream of the dam, the spillway capacity is adjudged as "seriously inadequate" and the dam is assessed as "unsafe,non-emergency."

Immediately upon receipt of this notification, a system for providing around-the-clock surveillance of the dam during periods of unusually heavy precipitation should be developed. An emergency action plan for the notification of downstream residents should also be developed.

Within 3 months of the date of notification of the owner, investigations into the deficiencies on this structure should be commenced. Studies of the structural stability including subsurface investigations are necessary. Information obtained should be incorporated into a detailed stability evaluation. Additional hydrologic/hydraulic investigations are also needed to find a method to correct the spillway inadequacy. These studies should be performed in conjunction with the stability analysis to determine the proper mitigating measures needed in response to the seriously inadequate spillway assessment. Remedial measures deemed necessary as a result of these investigations should be completed within 18 months.

Several other deficiencies were noted on this structure. These deficiencies should be corrected within 12 months of the date of notification of the owner. Among the required actions are the following:

1. Deteriorated and cracked concrete on the main dam and spillway section should be repaired.

2. Large trees growing at the downstream toe at the left end of the dam should be cut.

3. A program of regular maintenance, including periodic clearing debris from the spillway, should be established.

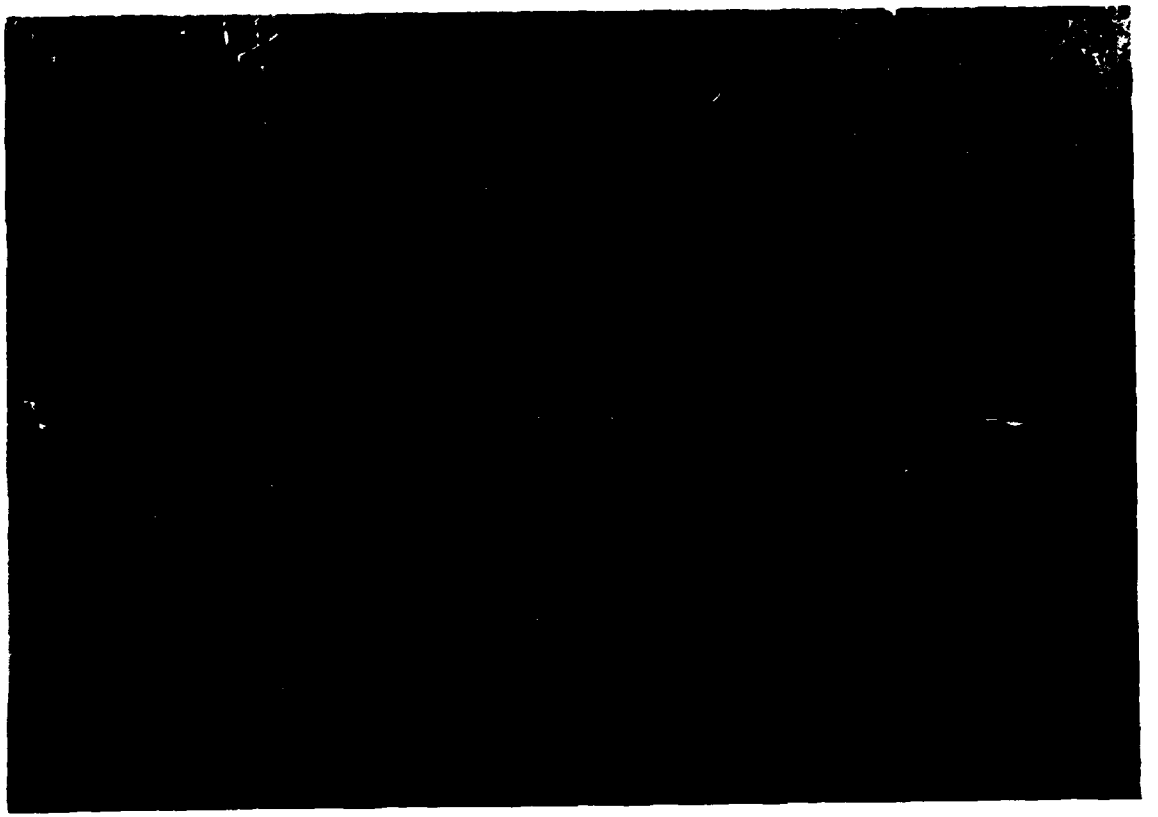
George Koch RW

George Koch
Chief, Dam Safety Section
New York State Department
of Environmental Conservation
NY License No. 45937

Approved By:

Col. W. M Smith Jr.
New York District Engineer

Date: 26 Aug 81



OVERVIEW
COLD SPRING DAM (UPPER)
I.D. NO. NY-106

Phase I Inspection Report
National Dam Safety Program
Cold Spring Dam (Upper)
I.D. NO. NY-106
#213-1004U Lower Hudson River Basin
Putnam County, New York

SECTION 1: PROJECT INFORMATION

1.1 GENERAL

a. Authority

The Phase I inspection reported herein was authorized by the Department of the Army, New York District, Corps of Engineers, to fulfill the requirements of the National Dam Inspection Act, Public Law 92-367.

b. Purpose of Inspection

This inspection was conducted to evaluate the existing conditions of the dam, to identify deficiencies and hazardous condition, to determine if these deficiencies constitute hazards to life and property, and to recommend remedial measures where required.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam

The Cold Spring Dam (Upper) is a laid up stone and concrete dam with an overflow spillway located at the right end of the dam. The dam is 270 ft. long and about 22 feet high. The crest width of the dam is 9 feet. The spillway section is founded on bedrock and consists of four openings of varying width. The first two openings, starting from the right end of the dam are each 7.7 feet wide. The next opening is 5.2 feet wide and the final opening is 5.8 feet wide. Each of the openings are about 2.5 feet high. Openings are separated by piers which vary from 1.1 to 2 feet in width. These piers support a 6 inch thick concrete foot bridge across the top of the spillway. The spillway discharges down a bedrock outcrop directly into the Cold Spring Lower Reservoir.

The structure has a low level outlet (reservoir drain) which is assumed to be a 12 inch diameter pipe, passing through the dam. The valve for this pipe is located in a rectangular concrete manhole in the reservoir. A short concrete bridge provides access between the dam crest and this manhole. The control mechanism for the valve is on the top of this manhole. The outlet for this pipe is submerged in the lower reservoir.

b. Location

This dam is located off Lake Surprise Road in the Town of Philipstown. It is approximately one mile west of New York State Route 9 and about 3 miles north of the Village of Cold Spring. The Cold Spring Lower Reservoir is located immediately downstream of this reservoir.

c. Size Classification

This dam is 22 feet high and has a storage capacity of approximately 88 acre-feet. Therefore, the dam is in the small size category as defined by the "Recommended Guidelines for the Safety Inspection of Dams."

d. Hazard Classification

This dam is classified as "high" hazard due to the presence of the Cold Spring Dam (Lower), two homes immediately downstream of that dam, and several other houses located near the stream channel approximately one mile downstream of the dam.

e. Ownership

This dam is owned by the Village of Cold Spring, whose mayor is Mr. Ronald A. McConville. His address is Cold Spring, New York 10516. His office telephone number is (914) 265-3611.

f. Purpose of Dam

This dam was originally constructed to impound water for the West Point Foundry. It was purchased by the Village of Cold Spring in about 1925 to provide an additional water supply. It continues to be used for this purpose.

g. Design and Construction History

This dam was reportedly constructed in about 1840. Since the composition of the structure is practically identical to that of the Lower Dam, reconstructed in the late 1930's, it is believed that modifications to this structure were made in the late 1930's as well. Minor modifications were made around 1960. These included refurbishing the gate control mechanism and patchwork of the concrete.

h. Normal Operating Procedures

There are no prescribed operating procedures for this structure. Water is discharged into the Lower Reservoir based on water supply requirements.

1.3 PERTINENT DATA

a. Drainage Area (acres)	464
b. Discharge at Dam (cfs)	
Spillway - Water Surface at Top of Dam	247
c. Elevation (USGS Datum)	
Top of Dam	649.4
Spillway Crest	647
d. Reservoir - Surface Area (acres)	
Top of Dam	11.1
Spillway Crest	9.2

e. Storage Capacity (acre-feet)

Top of Dam	88
Spillway Crest	61

f. Dam

Type: Laid up stone dam covered with concrete on crest and upstream face

Dam Length (ft.)	270
Crest Width (ft.)	9

g. Spillway

Type: Uncontrolled broad crested weir; divided into four segments which are separated by bridge piers; section width varies from 7.7 feet to 5.2 feet; all sections about 2.5 feet high.

Weir length	26.4

h. Low Level Outlet

Type: 12 inch diameter pipe (assumed size) which outlets at downstream toe; concrete manhole at upstream face contains valve controlling flow through pipe; valve stem extends to top of manhole; access to manhole via bridge from dam crest.

Control: Valve is reportedly operational.

SECTION 2: ENGINEERING DATA

2.1 DESIGN

a. Geology

The Cold Spring Dam (Upper) is located in the Hudson Hills segment of the New England Uplands physiographic province of New York State. These hills,commonly known as the "Highlands of the Hudson", are composed of crystalline rocks similar to those in the Adirondacks. The Highlands, which trend northeast-southwest, have been eroded to form very rugged terrain with summit levels reaching 1000 feet above sea level. Bedrock in the area consists of gneiss, quartzite and marble from the Precambrian era (more than 570 million years ago). A review of the Brittle Structures map of New York indicates that there are two faults within one mile of the dam. These are both fault traces but no further information was available.

Surficial soils in the area consist of glacial drift from the Wisconsin glaciation.

b. Subsurface Investigations

No records of any subsurface investigations performed for this structure were available.

2.2 DESIGN RECORDS

No design records could be located for this structure. The composition of this structure is similar to that of the Lower Dam, which is laid up stone and concrete. It is believed that this dam was reconstructed at about the same time as the Lower Dam.

2.3 CONSTRUCTION RECORDS

No construction records were available for this structure.

2.4 OPERATION RECORDS

No operation records were available for this structure.

2.5 EVALUATION OF DATA

Data used for the preparation of this report was obtained from the Department of Environmental Conservation files and from measurements taken during the visual inspection. Since no plans were available, the measurements made during the inspection were used to perform analyses required for this report.

SECTION 3: VISUAL INSPECTION

3.1 FINDINGS

a. General

Visual inspection of the Cold Spring Dam (Upper) was conducted on April 22, 1981. The weather was clear and the temperature was in the fifties. The water level at the time of the inspection was slightly above the spillway crest elevation.

b. Dam

This dam is composed of laid up stone with concrete covering the crest and upstream face. While the concrete was generally in satisfactory condition, there were several areas where some deterioration was noted. The worst of these areas was a 25 foot long segment of the upstream wall at the left end of the dam. There was extensive spalling on the downstream face of this wall and water was seeping through the base, onto the crest apron (see photographs). There was also some deteriorated and cracked concrete noted in the vicinity of joints on the upstream face at the left end of the dam. Several other cracks were noted which extended through the wall. Many of the joints and cracks had been patched to reduce further deterioration.

The downstream face of the dam appeared to be in satisfactory condition. There were a few missing stones and the overall alignment was fairly regular. Since the downstream toe was submerged, it was not possible to determine whether there was any leakage through the base of the dam. Several large trees were growing at the downstream toe near the left end of the structure.

c. Spillway

Cracking and voids were noted in the concrete forming the spillway section. These deficiencies were primarily on the portion forming the outflow apron. In addition, there was a crack in the wingwall which separates the spillway section from the remainder of the dam. This crack extended the length of the wall. There was seepage emerging from most of the length of this crack.

There was some debris blocking portions of the spillway channel. The relatively narrow spillway openings between the concrete piers were the cause of this debris accumulation.

d. Reservoir

The reservoir has relatively steep slopes beyond the edge of the impoundment. Rock outcrops were noted in the upper portions of the drainage area. There were no signs of soil instability in the reservoir area.

3.2 EVALUATION OF OBSERVATIONS

Visual observations revealed several deficiencies of this structure. The following items were noted:

1. Deterioration and cracking of concrete on the main dam and the spillway section.

2. Seepage through deteriorated concrete sections and joints in several areas.

3. Several large trees growing at the downstream toe near the left end of the dam.

4. Debris blocking portions of the spillway channel.

SECTION 4: OPERATION AND MAINTENANCE PROCEDURES

4.1 PROCEDURES

There are no prescribed operating procedures for this dam. The valve on the low level outlet pipe is opened when water is needed for the Village water supply. Water then flows into the reservoir, formed by Cold Spring Dam (Lower), from which it can be released as needed.

4.2 MAINTENANCE OF DAM

This dam is maintained by the Village of Cold Spring. There is no established maintenance plan but work is performed as required by village personnel.

4.3 WARNING SYSTEM IN EFFECT

There is no apparent warning system present for the evacuation of downstream residents.

4.4 EVALUATION

The operations and maintenance procedures on this dam are generally satisfactory. Some increase in maintenance effort is needed to correct deficiencies which exist.

SECTION 5: HYDROLOGIC/HYDRAULIC

5.1 DRAINAGE AREA CHARACTERISTICS

Delineation of the watershed draining into the reservoir pool was made using the USGS 7.5 minute quadrangle sheet for West Point, N.Y. The 464 acre drainage area consists of forested lands. Extensive rock outcrops were noted in the upper portions of the drainage area. Relief in the drainage area is steep with slopes of up to 50 percent. Hilltops within the drainage area rise to elevations of up to 450 feet above the normal lake level.

5.2 ANALYSIS CRITERIA

The analysis of the floodwater retarding capability of this dam was performed using the Corp of Engineers HEC-1 computer program, Dam Safety version. This program uses the Snyder Snythetic Unit hydrograph and the "Modified Puls" flood routing procedure. The spillway design flood selected for analysis was the Probable Maximum Flood (PMF) in accordance with the recommended guidelines of the U.S. Army Corps of Engineers. The PMF event is that hypothetical storm event resulting from the most critical combination of rainfall, minimum soil retention and direct runoff to a specific site that is considered reasonably possible for a particular watershed. Precipitation values used in the analysis were obtained from the Weather Bureau publication HMR 33. Soil retention rates selected were an initial loss of 2.0 inches and a constant loss of 0.16 inches per hour.

5.3 SPILLWAY CAPACITY

The dam has an ungated spillway at its right end. The spillway is composed of four openings separated by piers which support a concrete foot bridge across the top of the spillway. The spillway was analyzed as a broad crested weir with a discharge coefficient which varied according to the head. The effective length of the spillway was reduced to account for turbulence caused by the piers. The computed spillway capacity for the water surface at the top of the dam is 247 cfs.

5.4 RESERVOIR CAPACITY

Surcharge storage capacity of the reservoir between the spillway crest and the top of the dam is estimated to be 27 acre feet which is equivalent to a direct runoff depth of 0.70 inches over the drainage area. The total storage capacity of the dam is estimated to be 88 acre feet.

5.5 FLOODS OF RECORD

No information was available regarding the maximum known flood.

5.6 OVERTOPPING POTENTIAL

Analysis using the PMF and one-half PMF storm events indicates that the dam does not have sufficient spillway capacity. For the PMF, the peak inflow and outflow are both approximately 1152 cfs. The dam would be overtopped to a computed depth of 1.12 feet for this event. For one half of the PMF, the peak inflow and outflow are both about 574 cfs and the resulting depth of overtopping would be 0.54 feet. All storms exceeding 23% of the PMF will result in the dam being overtopped.

5.7 EVALUATION

Using the Corps of Engineer's screening criteria for initial review of spillway adequacy it has been determined that the dam would be overtopped by all storms exceeding 23% of the PMF. Stability analyses performed indicates that the dam is unstable when subjected to the depth of overtopping resulting from one-half the PMF. An overtopping induced failure would cause a sudden inflow surge into the lower reservoir, which then in turn could result in the failure of the Cold Spring Dam (Lower). Therefore, the spillway capacity has been adjudged to be seriously inadequate.

SECTION 6: STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

Visual inspection of the dam did not reveal deficiencies which would seriously affect the stability of the structure. Some deteriorated and spalling concrete was noted along a 25 foot long segment of the crest. There were also cracks and voids in the concrete which form the spillway section. The downstream face of the dam was in satisfactory condition with a few missing stones and a fairly regular alignment.

b. Data Review and Stability Evaluation

No plans or construction information could be located for this structure. The only information available for the preparation of this report was data obtained during the visual inspection. Measurements taken at that time were used to develop an approximate cross section of the dam (see Appendix D).A stability analysis was then performed using this cross section.

A stability analysis was performed for this report in accordance with the "Recommended Guidelines for the Safety Inspection of Dams." This analysis assumed full uplift pressure on the upstream face decreasing to the tailwater pressure at the downstream face. Ice loading, flood, and seismic conditions were analyzed. The results of the analyses are as follows:

Case	Overturning Safety Factor	Resultant in Middle Third	Sliding Safety Factor
a. Normal Conditions; Water Surface at spillway crest	1.39	No	1.15
b. Case a.) plus an ice load of 5000 lb/ft	1.03	No	0.85
c. 1/2 PMF flow; water surface 0.54 feet over the top of dam	1.16	No	0.88
d. PMF flow; water surface 1.12 feet over top of dam	1.13	No	0.84
e. Normal conditions with seismic coefficient of 0.10	1.33	No	0.82

The analyses indicates that the factors of safety for overturning and sliding are below recommended values for all conditions studied. The safety factors against sliding fall to critical levels when subjected to ice loading or the depth of overtopping resulting from either the PMF or 1/2 the PMF.

Further investigations are required to better assess the stability of the dam. Subsurface explorations are required to obtain information about the foundation material and the uplift forces. Accurate cross sections of the dam should also be obtained. Stability analyses should then be performed using this data. Based on the results of these analyses, required modifications to the structure should be made.

c. Seismic Stability

This structure is located in Seismic Zone 1. However, a seismic stability analysis was performed in accordance with Corps of Engineer Guidelines. The seismic analysis was performed for normal conditions with the water level at the spillway crest. The results of this analysis (shown on page 10) indicate that the safety factors against sliding are below 1.0 when seismic considerations are included.

SECTION 7: ASSESSMENT/RECOMMENDATIONS

7.1 ASSESSMENT

a. Safety

The Phase I inspection of the Cold Spring Dam (Upper) revealed several deficiencies. The structural stability analysis performed for this dam indicates that safety factors are below recommended values for all conditions studied. Safety factors fall to critical levels when the dam is subjected to ice loading or the depth of overtopping resulting from either the Probable Maximum Flood (PMF) or one half the PMF. Other deficiencies noted, such as deteriorated concrete along the crest and voids in the concrete forming the spillway section are relatively minor in nature.

The spillway capacity for this dam has been rated as seriously inadequate since it is not capable of passing one-half the PMF without overtopping the dam. Stability analyses performed indicates that under this loading condition the dam would be unstable. Since a failure of the dam would significantly increase the hazard to loss of life downstream of the dam, the spillway is adjudged as seriously inadequate and the dam is assessed as unsafe, non-emergency.

b. Adequacy of Information

The information which was available for the preparation of this report was extremely limited. Sketches developed from field measurements were used for stability analysis performed for this report. Some of the data used for hydrologic/hydraulic analysis was based on estimates as well.

c. Need for Additional Investigations

Further investigations of the structural stability of this dam are required. These studies should include subsurface explorations to obtain information about the dam's foundation and about uplift forces. This data should then be incorporated into a detailed stability evaluation.

Additional detailed hydrologic/hydraulic investigations are also necessary to correct the spillway discharge capacity inadequacy. These studies should be performed in conjunction with the stability analyses to determine the proper mitigating measures needed in response to the seriously inadequate spillway capacity.

d. Urgency

Investigations of the structural stability should be commenced within 3 months of the date of the notification of the owner. Remedial measures deemed necessary as a result of these investigations should be corrected within 18 months. Other deficiencies noted in Section 7.2 should be corrected within 12 months of the date of the notification of the owner.

7.2 RECOMMENDED MEASURES

1. After the structural stability analysis has been completed, appropriate remedial measures should be taken.

2. Take mitigating actions as necessary, based on the hydrolologic/ hydraulic investigations.

3. Deteriorated and cracked concrete on the main dam and the spillway section should be repaired.

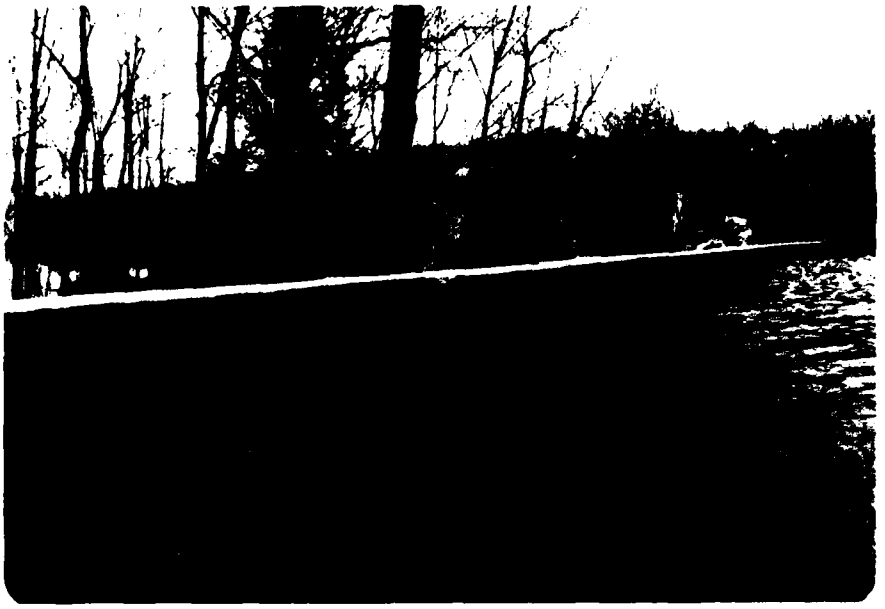
4. Large trees growing at the downstream toe at the left end of the dam should be cut.

5. A program of regular maintenance should be established including periodically clearing any debris blocking the spillway.

6. An emergency action plan for the notification of downstream residents should be developed.

APPENDIX A

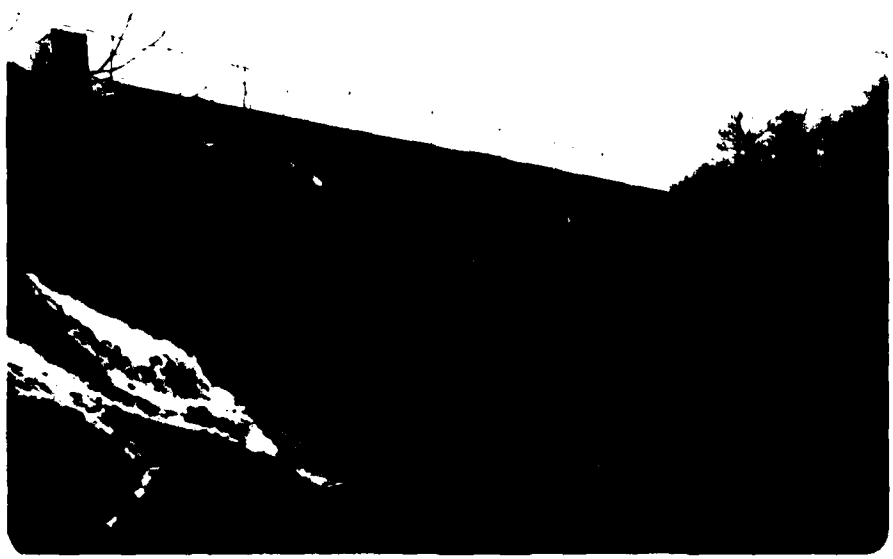
PHOTOGRAPHS



UPSTREAM FACE OF DAM
NOTE MINOR DETERIORATION AT JOINTS

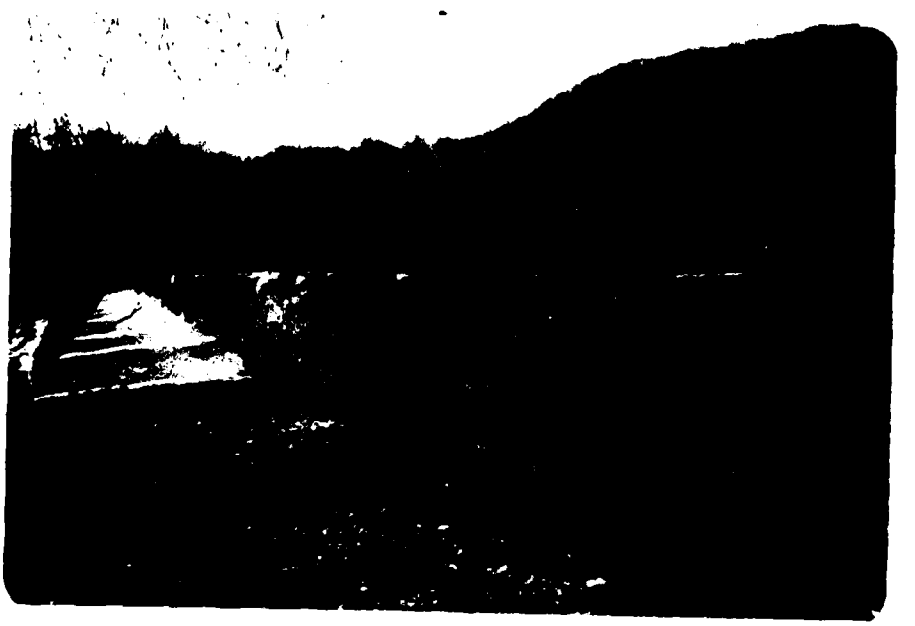
VIEW ALONG CREST OF DAM

DOWNSTREAM FACE OF DAM



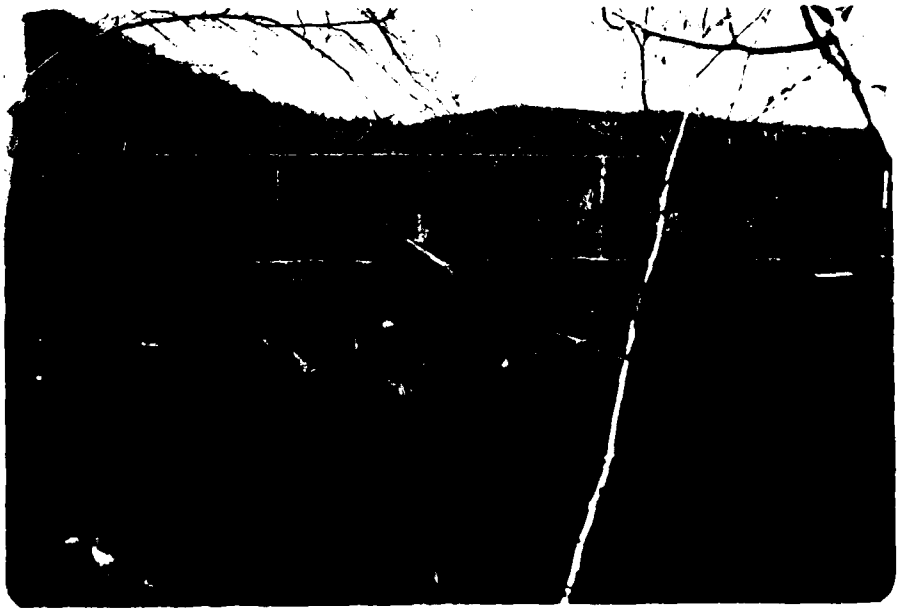
DOWNSTREAM FACE OF DAM
FROM RIGHT END OF DAM

OVERVIEW OF DOWNSTREAM
FACE FROM RIGHT END OF DAM



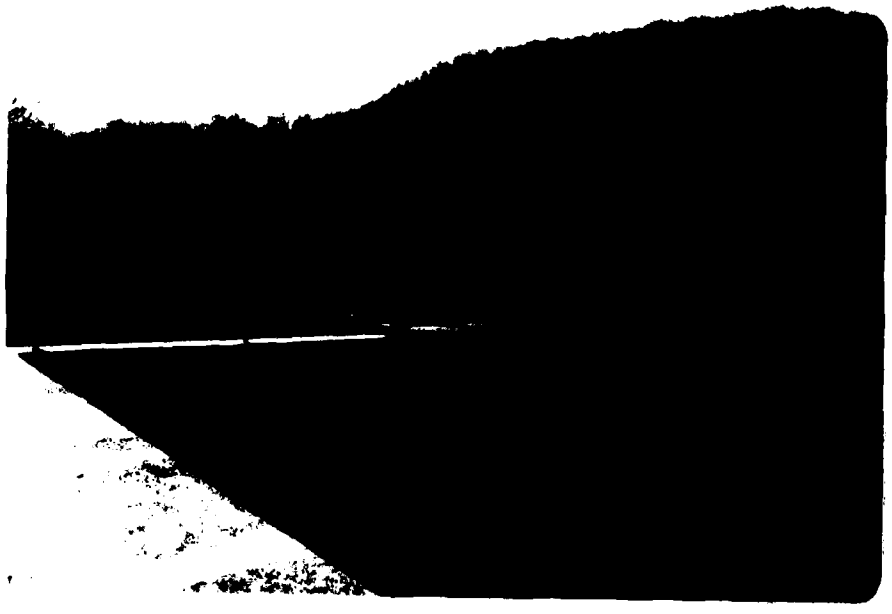
DETERIORATED 25' LONG SECTION
NEAR LEFT END OF DAM -NOTE MINOR SEEPAGE

UPSTREAM END OF SPILLWAY SECTION



SPILLWAY CHANNEL, NOTE DEBRIS IN CHANNELS

CRACKED WINGWALL ADJACENT
TO SPILLWAY SECTION



GATE CONTROL MECHANISM
TOWER IN RESERVOIR

APPENDIX B

VISUAL INSPECTION CHECKLIST

93-15-3(9/80)

VISUAL INSPECTION CHECKLIST

1) Basic Data

a. General

Name of Dam COLD SPRING DAM UPPER

Fed. I.D. # 106 DEC Dam No. 213-1004 U

River Basin LOWER HUDSON

Location: Town PHILIPSTOWN County PUTNAM

Stream Name FOUNDRY BROOK

Tributary of

Latitude (N) 41° 28.1' Longitude (W) 73° 56.4'

Type of Dam CONCRETE AND LAID UP STONE

Hazard Category C

Date(s) of Inspection 4/22/81

Weather Conditions 50° SUNNY

Reservoir Level at Time of Inspection 2.15' BELOW TOP OF DAM

b. Inspection Personnel R. WARRENDER W. LYNICK

c. Persons Contacted (Including Address & Phone No.)

RONALD MC CONVILLE, MAYOR, VILLAGE OF COLD SPRING

COLD SPRING, N.Y. 10516 914-265-3611

d. History:

Date Constructed 1840? Date(s) Reconstructed 1930?

Designer

Constructed By

Owner VILLAGE OF COLD SPRING

93-15-3(9/90) No Embankment So No. 2 Not Included

(1) Erosion at Contact _____

(2) Seepage Along Contact _____

3) Drainage System

a. Description of System NONE

b. Condition of System _____

c. Discharge from Drainage System _____

4) Instrumentation (Momumentation/Surveys, Observation Wells, Weirs, Piezometers etc.) _____

NONE

93-15-3(9/80)

5) Reservoir

a. Slopes STEEP - ROCK OUTCROPS IN UPPER PART OF WATERSHED

b. Sedimentation NONE APPARENT

c. Unusual Conditions Which Affect Dam

6) Area Downstream of Dam

a. Downstream Hazard (No. of Homes, Highways, etc.) LOWER DAM SEVERAL HOUSES BELOW IT

b. Seepage, Unusual Growth LOWER RESERVOIR - DOWNSTREAM UNOBSERVABLE SEVERAL LARGE TREES IMMEDIATELY DOWSTREAM OF LEFT END

c. Evidence of Movement Beyond Toe of Dam COULD NOT BE SEEN

d. Condition of Downstream Channel LOWER RESERVOIR

7) Spillway(s) (Including Discharge Conveyance Channel)

CONCRETE CHANNEL AT RIGHT END - SEPARATED INTO 4 SEGMENTS BY PIERS

a. General PIERS SEPARATE SPILLWAY BAYS - CONCRETE FOOT BRIDGE GOES ACROSS TOP.

b. Condition of ~~Service~~ Spillway SOME DEBRIS CAUGHT BETWEEN PIERS SOME DETERIORATION OF CONCRETE ON SECTION - SPALLING, CRACKING & SOME VOIDS NOTED ON SPILLWAY CONCRETE CRACKS & SEEPAGE NOTED THROUGH CONCRETE WALL WHICH SEPARATES SPILLWAY FROM REMAINDER OF DAM

c. Condition of Auxiliary Spillway NONE

d. Condition of Discharge Conveyance Channel LOWER RESERVOIR

8) Reservoir Drain/Outlet

Type: Pipe ✓ Conduit _____ Other _____

Material: Concrete _____ Metal _____ Other _____

Size: _____ Length _____

Invert Elevations: Entrance _____ Exit _____

Physical Condition (Describe): Unobservable ✓

Material: _____

Joints: _____ Alignment _____

Structural Integrity: _____

Hydraulic Capability: _____

Means of Control: Gate ✓ Valve _____ Uncontrolled _____

Operation: Operable ✓ Inoperable _____ Other _____

Present Condition (Describe): GATE TOWER ACCESS FROM CREST OF DAM - APPEARED IN GOOD CONDITION

93-25-3(9/80)

9) Structural

a. Concrete Surfaces SOME CRACKING & DETERIORATION – 25' LONG SECTION OF VERTICAL DOWNSTREAM FACE OF "PARAPET" WALL ON CREST WAS SERIOUSLY SPALLING – SOME SEEPAGE THROUGH THIS SEGMENT IN ONE AREA SEVERAL OTHER AREAS WHERE MINOR SPALLING NOTED

NEAR LEFT END OF DAM →

b. Structural Cracking SOME CRACKS IN CREST CONCRETE – MOST HAD BEEN SEALED WITH JOINT SEALING MATERIAL NOT TOO LONG AGO – SOME CRACKS ON U.S. FACE AT LEFT END W/SOME CONC. REMOVAL

c. Movement - Horizontal & Vertical Alignment (Settlement) ALIGNMENT APPEARS TO BE FAIRLY REGULAR D.S. FACE REGULAR WITH VERY FEW MISSING OR DISPLACED STONES

d. Junctions with Abutments or Embankments ROCK ON RIGHT END – OK LEFT END IS SOIL

e. Drains - Foundation, Joint, Face NONE

f. Water Passages, Conduits, Sluices

g. Seepage or Leakage MINOR SEEPAGE THROUGH THE 25' LONG DETERIORATED SECTION

h. Joints - Construction, etc. SEALED WITH JOINT SEALING MATERIAL

i. Foundation UNOBSERVABLE

j. Abutments SATISFACTORY

k. Control Gates UNOBSERVABLE

l. Approach & Outlet Channels N/A

m. Energy Dissipators (Plunge Pool, etc.) LOWER RESERVOIR

n. Intake Structures CONCRETE BOX WITH MANHOLE DOWN TO GATE FOR RES. DRAIN - LOW LEVEL OUTLET. LOCATED IN RESERVOIR - APPEARED TO BE IN SATISFACTORY CONDITION.

o. Stability

p. Miscellaneous

NO OTHER APPURTENANT STRUCTURES

APPENDIX C

HYDROLOGIC/HYDRAULIC ENGINEERING DATA AND COMPUTATIONS

CHECK LIST FOR DAMS
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

AREA-CAPACITY DATA:

	Elevation (ft.)	Surface Area (acres)	Storage Capacity (acre-ft.)
1) Top of Dam	649.4		88
2) Design High Water (Max. Design Pool)	N/A		
3) ~~Auxiliary~~ Spillway Crest	647		61
4) Pool Level with Flashboards	N/A		
5) Service Spillway Crest	N/A		

DISCHARGES

	Volume (cfs)
1) Average Daily	N/A
2) Spillway @ Maximum High Water	88
3) Spillway @ Design High Water	N/A
4) Spillway @ Auxiliary Spillway Crest Elevation	N/A
5) Low Level Outlet	N/A
6) Total (of all facilities) @ Maximum High Water	88
7) Maximum Known Flood	N/A
8) At Time of Inspection	N/A

CREST: ELEVATION: 649.4

Type: CONCRETE OVER LAID UP STONE

Width: 9' Length: [redacted] 233

Spillover CONCRETE CHANNEL

Location LEFT END OF DAM

SPILLWAY:

[redacted]		AUXILIARY
647	Elevation	N/A
CONCRETE CHANNELS	Type	
VARIES WITH H	Width	
	Type of Control	
√	Uncontrolled	
	Controlled:	
	Type (Flashboards; gate)	
	Number	
	Size/Length	
	Invert Material	
	Anticipated Length of operating service	
	Chute Length	
	Height Between Spillway Crest & Approach Channel Invert (Weir Flow)	

HYDROMETEROLOGICAL GAGES:

Type : NONE

Location: _____

Records:

Date - _____

Max. Reading - _____

FLOOD WATER CONTROL SYSTEM:

Warning System: NONE

_____

Method of Controlled Releases (mechanisms):

LOW LEVEL OUTLET WITH GATE

_____

DRAINAGE AREA: 463.7 ACRES

DRAINAGE BASIN RUNOFF CHARACTERISTICS:

Land Use - Type: FOREST

Terrain - Relief: STEEP

Surface - Soil: THIN TILL

Runoff Potential (existing or planned extensive alterations to existing (surface or subsurface conditions)

NONE

Potential Sedimentation problem areas (natural or man-made; present or future)

NONE

Potential Backwater problem areas for levels at maximum storage capacity including surcharge storage:

NONE

Dikes - Floodwalls (overflow & non-overflow) - Low reaches along the Reservoir perimeter:

Location: _____

Elevation: _____

Reservoir:

Length @ Maximum Pool _____ (Miles)

Length of Shoreline (@ Spillway Crest) _____ (Miles)

00-15-1 (3/78)
Formerly CA-17

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

PROJECT GRID

JOB	SHEET NO.	CHECKED BY	DATE
COLD SPRING UPPER RESERVOIR DAM	1		
SUBJECT		COMPUTED BY	DATE
WATERSHED PARAMETERS		RLW	4/10/81

DRAINAGE AREA

USGS 7.5' QUAD — PLANIMETERED AT 5.05 IN² = 463.7 ACRES

BASE FLOW:

INITIAL AT 1 CSM = 1 CFS

QRCSN = .1 (10% OF PEAK Q)

RTIOR = 1.5

LOSSES (SOIL INFILTRATION)

INITIAL = 2.00

CONSTANT = 0.16

{ FROM CORPS OF ENGINEERS LOWER HUDSON RIVER BASIN MODEL STUDY USING FISHKILL CREEK

RAINFALL - PMP

REC: HMR #33

ZONE 1 INDEX PMP = 21.4 IN (200 SQ MI / 24 HR)

ADJUSTMENT FOR TIME & DA

DURATION →	6	12	24	48 (HRS)
% OF INDEX =	111	123	132	142

[LOWER LIMIT OF CHART FOR 10 SQ. MI.] ↑

00-15-1 (3/78)
Formerly GA-17

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

PROJECT GRID

JOB	SHEET NO.	CHECKED BY	DATE
COLD SPRING UPPER RESERVOIR DAM	2		
SUBJECT		**COMPUTED BY**	**DATE**
WATERSHED PARAMETERS		RLW	4/13/81

SNYDER UNIT HYDROGRAPH:

$L = 1.36 \text{ mi} = 7181 \text{ ft}$

$L_{CA} = 0.83 \text{ mi} = 4382 \text{ ft}$

USE $C_t = 2.40$ ← FROM { CORPS OF ENGINEERS, LOWER HUDSON RIVER BASIN HYDROLOGIC FLOOD ROUTING MODEL

LAG TIME (HRS):

$$t_p = C_t (L \times L_{CA})^{0.3}$$

$$(2.4)[1.36 \cdot 0.83]^{.3} = 2.49 \text{ HRS}$$

UNIT RAINFALL DURATION (HRS): $t_r = \frac{t_p}{5.5}$

$$t_r = \frac{2.49 \text{ HRS}}{5.5} = .45 \text{ HOURS}$$

$t_r = .45$ HOURS ← USE .50 HOURS

ADJUSTED LAG TIME (HOURS)

$$TP = t_p + .25(t_R - t_r)$$

$$= 2.49 - .25(.50 - .45) = 2.50$$

$TP = 2.50$

PEAKING COEFFICIENT

$640 C_p = 282$ FROM SUBBASIN 5 FISHKILL CREEK (LOWER HUDSON BASIN STUDY)

$C_p = 0.44$

SNYDER COEFFICIENTS $TP = 2.50$ $CP = 0.44$

00-15-1 (3/78)
Formerly GA-17

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

PROJECT GRID

JOB	SHEET NO.	CHECKED BY	DATE
Cold Spring Upper Reservoir Dam	3		
SUBJECT		**COMPUTED BY**	**DATE**
Stage - Storage Data		RLW	5/26/81

Surface Area - (Based on USGS Sheet)

Normal Pool (Elev. 647) - $0.10\ in^2 \Rightarrow 9.2$ Acres

Elev. 660 Contour Line - $0.21\ in^2 \Rightarrow 19.3$ Acres

Computed Storage Capacity

Height To Spillway Crest (Normal Water) = 19.75 Ft

$$V = \frac{\text{Area (Height)}}{3} = \frac{(9.2\ \text{Acres})(19.75\ \text{Ft})}{3} = 60.6\ \text{Ac·Ft.}$$

Capacity At 660 Contour

$$V = \frac{19.3(32.75)}{3} = 211\ \text{Ac·Ft}$$

00-15-1 (3/78)
Formerly GA-17

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

PROJECT GRID

JOB	SHEET NO.	CHECKED BY	DATE
COLD SPRING UPPER RESERVOR DAM	4		
SUBJECT		**COMPUTED BY**	**DATE**
SPILLWAY DISCHARGES		RLW	5/26/81

SPILLWAY WILL ACT AS A BROAD CRESTED WEIR

$Q = CLH^{3/2}$

$L = L' - 2(NK_p + K_a)H \Rightarrow L = 26.45 - 2(.06 + .2)H = 26.45 - .52H$

$L' = 26.45$ $K_p = 0.02$ $N = 3$ $K_a = 0.20$

C - VARIES WITH H USE TABLE 5.3 KING & BRATER

ELEVATION	H	L	C	Q(cfs)
647	0	-	-	-
	0.5	26.19	2.63	24.3
	1	25.93	2.68	69.5
	1.5	25.67	2.66	125.4
	2	25.41	2.64	189.7
TOP OF DAM 649.4	2.4	25.20	2.64	247.3
	3.5	24.63	2.64	425.8
	5.0	23.85	2.64	703.9

TOP OF DAM - BROAD CRESTED WIER -

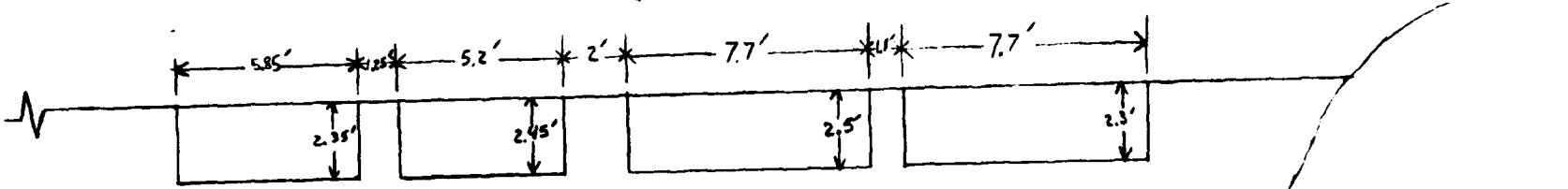
$Q = CLH^{3/2}$ $L = 233$

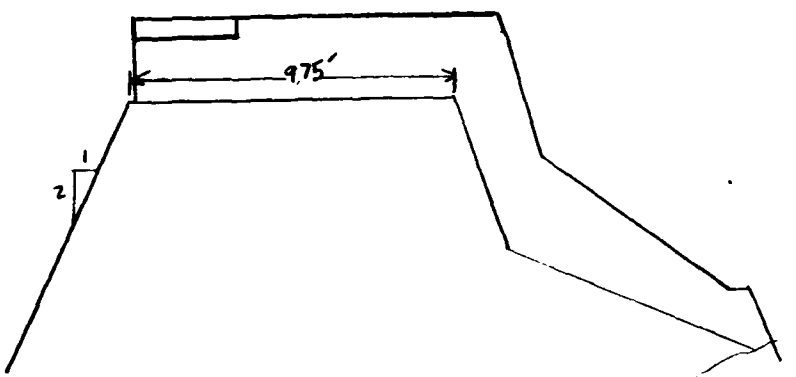
ELEVATION	H	C	Q(cfs) ↙ TO BE ADDED TO SPILLWAY FLOWS
649.4	0	-	-
649.6	0.2	2.44	50.8
650.0	0.6	2.68	289.1
650.4	1.0	2.65	617.4
651.4	2.0	2.72	1792.4

COLD SPRING UPPER DAM

SPILLWAY SECTION

SPILLWAY SECTION





SECTIONAL VIEW

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  26 FEB 79
  MODIFIED FOR HONEYWELL APR 79
**********

**********
NEW YORK STATE
DEPT OF ENVIRONMENTAL CONSERVATION
FLOOD PROTECTION BUREAU
**********

    1              A1 NY 106 COLD SPRING DAM UPPER
    2              A2 HEC-1 PMF WITH RATIOS
    3              A3 DATE
    4              3    150       0      30       0       0       0       0       0       0       0
    5              B1     5
    6              J      1       4       1
    7              J1   .23     .24     .50    1.0
    8              K      0       1                                       1
    9              K1  INFLOW HYDROGRAPH  UPPER RESERVOIR
   10              H      1       1     .72                                               1
   11              P                  21.4     111     123     132     142
   12              T                                                       2.0    0.16
   13              W    2.5     .44
   14              X      1      -.1     1.5
   15              K      1   UPDAM                                       1
   16              K1     ROUTED HYDROGRAPH UPPER DAM
   17              Y                                  1       1
   18              YI     1                                               -647      -1
   19              Y4   647   647.5     648   648.5     649   649.4   650.5     652
   20              Y5     0    24.3    69.5   125.4   189.7   247.3   425.8   703.9
   21              $S     0    60.6     211
   22              $E627.25     647     660
   23              $$   647
   24              $D 649.4     2.6     1.5     233
   25              K     99
   26              A
   27              A
   28              A
   29              A
   30              A
```

```
**********                                        **********
FLOOD HYDROGRAPH PACKAGE (HEC-1)                  NEW YORK STATE
DAM SAFETY VERSION      JULY 1978                 DEPT OF ENVIRONMENTAL CONSERVATION
  LAST MODIFICATION  26 FEB 79                    FLOOD PROTECTION BUREAU
  MODIFIED FOR HONEYWELL APR 79
**********                                        **********

RUN  DATE 08/12/81
                    NY 106 COLD SPRING DAM UPPER
                    HEC-1 PMF WITH RATIOS
                    DATE

                                    JOB SPECIFICATION
      NQ      NHR     NMIN    IDAY     IHR     IMIN    METRC    IPLT    IPRT   NSTAN
     150        0       30       0       0        0        0       0       0       0
                                JOPER     NWT   LROPT   TRACE
                                    5       0       0       0


                              MULTI-PLAN ANALYSES TO BE PERFORMED
                                    NPLAN= 1 NRTIO= 4 LRTIO= 1
                       RTIOS=   0.23    0.24    0.50    1.00

**********      **********      **********      **********      **********

                                SUB-AREA RUNOFF COMPUTATION

                    INFLOW HYDROGRAPH  UPPER RESERVOIR
                                ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                                    1       0       0       0       0       0       1       0       0

                                    HYDROGRAPH DATA
                    IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
                        1       1    0.72      0.    0.72      0.      0.          0       1       0

                                    PRECIP DATA
                              SPFE     PMS       R6      R12      R24      R48      R72      R96
                              0.     21.40   111.00   125.00   132.00   142.00     0.       0.
TRSPC COMPUTED BY THE PROGRAM IS 0.800

                                    LOSS DATA
                LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
                    0      0.      0.    1.00      0.      0.    1.00    2.00    0.16      0.      0.

                                UNIT HYDROGRAPH DATA
                                TP=  2.50    CP=0.44    NTA=  0

                                RECESSION DATA
                                STRTQ=    1.00    QRCSN=   -0.10    RTIOR= 1.50
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 5.40 AND R= 8.09 INTERVALS

                UNIT HYDROGRAPH 46 END-OF-PERIOD ORDINATES, LAG=   2.51 HOURS, CP= 0.44  VOL= 1.00
      6.      23.      45.      67.      80.      81.      73.      64.      57.      50.
     44.      39.      35.      31.      27.      24.      21.      19.      17.      15.
     13.      11.      10.       9.       8.       7.       6.       5.       5.       4.
      4.       3.       3.       3.       2.       2.       2.       2.       1.       1.
      1.       1.       1.       1.       1.       1.

    0                               END-OF-PERIOD FLOW
```

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	0.30	1	0.00	0.	0.00	1.	1.02	14.00	76	1.14	1.06	0.08	183.
1.01	1.00	2	0.00	0.	0.00	1.	1.02	14.30	77	1.43	1.35	0.08	258.
1.01	1.30	3	0.00	0.	0.00	1.	1.02	15.00	78	1.43	1.35	0.08	342.
1.01	2.00	4	0.00	0.	0.00	1.	1.02	15.30	79	1.73	1.65	0.08	430.
1.01	2.30	5	0.00	0.	0.00	1.	1.02	16.00	80	5.49	5.41	0.08	546.
1.01	3.00	6	0.00	0.	0.00	1.	1.02	16.30	81	1.33	1.25	0.08	702.
1.01	3.30	7	0.00	0.	0.00	1.	1.02	17.00	82	1.33	1.25	0.08	874.
1.01	4.00	8	0.00	0.	0.00	1.	1.02	17.30	83	1.05	0.97	0.08	1027.
1.01	4.30	9	0.00	0.	0.00	1.	1.02	18.00	84	1.05	0.97	0.08	1126.
1.01	5.00	10	0.00	0.	0.00	1.	1.02	18.30	85	0.08	0.	0.08	1154.
1.01	5.30	11	0.00	0.	0.00	1.	1.02	19.00	86	0.08	0.	0.08	1117.
1.01	6.00	12	0.00	0.	0.00	1.	1.02	19.30	87	0.08	0.	0.08	1048.
1.01	6.30	13	0.01	0.	0.01	1.	1.02	20.00	88	0.08	0.	0.08	958.
1.01	7.00	14	0.01	0.	0.01	1.	1.02	20.30	89	0.08	0.	0.08	858.
1.01	7.30	15	0.01	0.	0.01	1.	1.02	21.00	90	0.08	0.	0.08	759.
1.01	8.00	16	0.01	0.	0.01	1.	1.02	21.30	91	0.08	0.	0.08	671.
1.01	8.30	17	0.01	0.	0.01	1.	1.02	22.00	92	0.08	0.	0.08	593.
1.01	9.00	18	0.01	0.	0.01	0.	1.02	22.30	93	0.08	0.	0.08	524.
1.01	9.30	19	0.01	0.	0.01	0.	1.02	23.00	94	0.08	0.	0.08	463.
1.01	10.00	20	0.01	0.	0.01	0.	1.02	23.30	95	0.08	0.	0.08	409.
1.01	10.30	21	0.01	0.	0.01	0.	1.03	0.	96	0.08	0.	0.08	361.
1.01	11.00	22	0.01	0.	0.01	0.	1.03	0.30	97	0.	0.	0.	319.
1.01	11.30	23	0.01	0.	0.01	0.	1.03	1.00	98	0.	0.	0.	282.
1.01	12.00	24	0.01	0.	0.01	0.	1.03	1.30	99	0.	0.	0.	249.
1.01	12.30	25	0.07	0.	0.07	0.	1.03	2.00	100	0.	0.	0.	220.
1.01	13.00	26	0.07	0.	0.07	0.	1.03	2.30	101	0.	0.	0.	195.
1.01	13.30	27	0.09	0.	0.09	0.	1.03	3.00	102	0.	0.	0.	172.
1.01	14.00	28	0.09	0.	0.09	0.	1.03	3.30	103	0.	0.	0.	152.
1.01	14.30	29	0.11	0.	0.11	0.	1.03	4.00	104	0.	0.	0.	134.
1.01	15.00	30	0.11	0.	0.11	0.	1.03	4.30	105	0.	0.	0.	119.
1.01	15.30	31	0.13	0.	0.13	0.	1.03	5.00	106	0.	0.	0.	112.
1.01	16.00	32	0.42	0.	0.42	0.	1.03	5.30	107	0.	0.	0.	107.
1.01	16.30	33	0.10	0.	0.10	0.	1.03	6.00	108	0.	0.	0.	103.
1.01	17.00	34	0.10	0.	0.10	0.	1.03	6.30	109	0.	0.	0.	99.
1.01	17.30	35	0.08	0.	0.08	0.	1.03	7.00	110	0.	0.	0.	95.
1.01	18.00	36	0.08	0.	0.08	0.	1.03	7.30	111	0.	0.	0.	91.
1.01	18.30	37	0.01	0.	0.01	0.	1.03	8.00	112	0.	0.	0.	88.
1.01	19.00	38	0.01	0.	0.01	0.	1.03	8.30	113	0.	0.	0.	84.
1.01	19.30	39	0.01	0.	0.01	0.	1.03	9.00	114	0.	0.	0.	81.
1.01	20.00	40	0.01	0.	0.01	0.	1.03	9.30	115	0.	0.	0.	78.
1.01	20.30	41	0.01	0.	0.01	0.	1.03	10.00	116	0.	0.	0.	75.
1.01	21.00	42	0.01	0.	0.01	0.	1.03	10.30	117	0.	0.	0.	72.
1.01	21.30	43	0.01	0.	0.01	0.	1.03	11.00	118	0.	0.	0.	69.
1.01	22.00	44	0.01	0.	0.01	0.	1.03	11.30	119	0.	0.	0.	66.
1.01	22.30	45	0.01	0.	0.01	0.	1.03	12.00	120	0.	0.	0.	63.
1.01	23.00	46	0.01	0.	0.01	0.	1.03	12.30	121	0.	0.	0.	61.
1.01	23.30	47	0.01	0.	0.01	0.	1.03	13.00	122	0.	0.	0.	58.
1.02	0.	48	0.01	0.	0.01	0.	1.03	13.30	123	0.	0.	0.	56.
1.02	0.30	49	0.05	0.	0.05	0.	1.03	14.00	124	0.	0.	0.	54.
1.02	1.00	50	0.05	0.	0.05	0.	1.03	14.30	125	0.	0.	0.	52.
1.02	1.30	51	0.05	0.	0.05	0.	1.03	15.00	126	0.	0.	0.	50.
1.02	2.00	52	0.05	0.	0.05	0.	1.03	15.30	127	0.	0.	0.	48.
1.02	2.30	53	0.05	0.	0.05	0.	1.03	16.00	128	0.	0.	0.	46.
1.02	3.00	54	0.05	0.	0.05	0.	1.03	16.30	129	0.	0.	0.	44.
1.02	3.30	55	0.05	0.	0.05	0.	1.03	17.00	130	0.	0.	0.	42.
1.02	4.00	56	0.05	0.	0.05	0.	1.03	17.30	131	0.	0.	0.	41.
1.02	4.30	57	0.05	0.	0.05	0.	1.03	18.00	132	0.	0.	0.	39.
1.02	5.00	58	0.05	0.	0.05	0.	1.03	18.30	133	0.	0.	0.	37.
1.02	5.30	59	0.05	0.	0.05	0.	1.03	19.00	134	0.	0.	0.	36.
1.02	6.00	60	0.05	0.	0.05	0.	1.03	19.30	135	0.	0.	0.	35.

1.02	6.30	61	0.17	0.09	0.08	1.	1.03	20.00	136	0.	0.	0.	33.
1.02	7.00	62	0.17	0.09	0.08	3.	1.03	20.30	137	0.	0.	0.	32.
1.02	7.30	63	0.17	0.09	0.08	7.	1.03	21.00	138	0.	0.	0.	31.
1.02	8.00	64	0.17	0.09	0.08	13.	1.03	21.30	139	0.	0.	0.	29.
1.02	8.30	65	0.17	0.09	0.08	20.	1.03	22.00	140	0.	0.	0.	28.
1.02	9.00	66	0.17	0.09	0.08	28.	1.03	22.30	141	0.	0.	0.	27.
1.02	9.30	67	0.17	0.09	0.08	34.	1.03	23.00	142	0.	0.	0.	26.
1.02	10.00	68	0.17	0.09	0.08	40.	1.03	23.30	143	0.	0.	0.	25.
1.02	10.30	69	0.17	0.09	0.08	45.	1.04	0.	144	0.	0.	0.	24.
1.02	11.00	70	0.17	0.09	0.08	50.	1.04	0.30	145	0.	0.	0.	23.
1.02	11.30	71	0.17	0.09	0.08	54.	1.04	1.00	146	0.	0.	0.	22.
1.02	12.00	72	0.17	0.09	0.08	58.	1.04	1.30	147	0.	0.	0.	21.
1.02	12.30	73	0.95	0.87	0.08	65.	1.04	2.00	148	0.	0.	0.	20.
1.02	13.00	74	0.95	0.87	0.08	86.	1.04	2.30	149	0.	0.	0.	20.
1.02	13.30	75	1.14	1.06	0.08	125.	1.04	3.00	150	0.	0.	0.	19.
									SUM	24.31	19.14	5.17	19255.
										(617.)	(486.)	(131.)	(545.24)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1154.	905.	371.	134.	19251.
CMS	33.	26.	11.	4.	545.
INCHES		11.70	19.17	20.72	20.73
MM		297.14	486.92	526.33	526.45
AC-FT		449.	736.	795.	795.
THOUS CU M		554.	908.	981.	981.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 1

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	1.	2.	3.	5.	6.	8.	9.	10.	11.
12.	13.	15.	20.	29.	42.	59.	79.	99.	126.
161.	201.	236.	259.	265.	257.	241.	220.	197.	175.
154.	136.	120.	106.	94.	83.	73.	65.	57.	51.
45.	40.	36.	31.	27.	26.	25.	24.	23.	22.
21.	20.	19.	19.	18.	17.	16.	16.	15.	15.
14.	13.	13.	12.	12.	11.	11.	11.	10.	10.
9.	9.	9.	8.	8.	8.	7.	7.	7.	6.
6.	6.	6.	6.	5.	5.	5.	5.	5.	4.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	265.	208.	85.	31.	4428.
CMS	8.	6.	2.	1.	125.
INCHES		2.69	4.41	4.77	4.77
MM		68.34	111.99	121.06	121.08
AC-FT		103.	169.	183.	183.
THOUS CU M		127.	209.	226.	226.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 2

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

0.	1.	2.	3.	5.	7.	8.	10.	11.	12.
13.	14.	16.	21.	30.	44.	62.	83.	103.	131.
168.	210.	246.	271.	277.	268.	252.	230.	206.	182.
161.	142.	126.	111.	98.	87.	77.	68.	60.	53.
47.	41.	36.	32.	28.	27.	26.	25.	24.	23.
22.	21.	20.	19.	19.	18.	17.	17.	16.	15.
15.	14.	13.	13.	12.	12.	11.	11.	11.	10.
10.	9.	9.	9.	8.	8.	8.	7.	7.	7.
6.	6.	6.	6.	6.	5.	5.	5.	5.	5.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	277.	217.	89.	32.	4620.
CMS	8.	6.	3.	1.	131.
INCHES		2.81	4.60	4.97	4.97
MM		71.31	116.86	126.32	126.35
AC-FT		108.	177.	191.	191.
THOUS CU M		133.	218.	235.	235.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 3

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	1.	3.	6.	10.	14.	17.	20.	23.	25.
27.	29.	33.	43.	62.	92.	129.	171.	215.	273.
351.	437.	513.	564.	577.	559.	524.	479.	429.	380.
335.	296.	262.	231.	204.	181.	160.	141.	125.	110.
97.	86.	76.	67.	59.	56.	54.	52.	50.	48.
46.	44.	42.	40.	39.	37.	36.	34.	33.	32.
30.	29.	28.	27.	26.	25.	24.	23.	22.	21.
20.	19.	19.	18.	17.	17.	16.	15.	15.	14.
14.	13.	12.	12.	12.	11.	11.	10.	10.	9.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	577.	453.	185.	57.	9625.
CMS	16.	13.	5.	2.	273.
INCHES		5.85	9.59	10.36	10.36
MM		148.57	243.46	263.16	263.22
AC-FT		224.	368.	398.	398.
THOUS CU M		277.	454.	490.	491.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 4

1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.	5.	7.	13.	20.	28.	34.	40.	45.	50.
54.	58.	65.	86.	125.	183.	258.	342.	450.	546.
702.	874.	1027.	1128.	1154.	1117.	1048.	958.	858.	759.
671.	593.	524.	463.	409.	361.	319.	282.	249.	220.
195.	172.	152.	134.	119.	112.	107.	103.	99.	95.
91.	88.	84.	81.	78.	75.	72.	69.	66.	63.
61.	58.	56.	54.	52.	50.	48.	46.	44.	42.
41.	39.	37.	36.	35.	33.	32.	31.	29.	28.
27.	26.	26.	24.	23.	22.	21.	20.	20.	19.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1154.	905.	371.	134.	19251.
CMS	33.	26.	11.	4.	545.
INCHES		11.70	19.17	20.72	20.73
MM		297.14	486.92	526.33	526.45
AC-FT		449.	736.	795.	795.
THOUS CU M		554.	908.	981.	981.

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HYDROGRAPH ROUTING

ROUTED HYDROGRAPH UPPER DAM

	ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
	UPDAM	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.	0.	0.	1	1	0	0	0

NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.	0.	0.	-647.	-1

STAGE	647.00	647.50	648.00	648.50	649.00	649.40	650.50	652.00
FLOW	0.	24.30	69.50	125.40	189.70	247.30	425.80	703.90
CAPACITY=	0.	61.	211.					
ELEVATION=	627.	647.	660.					

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
647.0	0.	0.	0.	0.	0.	0.	0.

DAM DATA

TOPEL	COQD	EXPD	DAMWID
649.4	2.6	1.5	233.

STATION UPDAM, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	1.	1.	2.	3.	4.	5.	6.
7.	8.	9.	10.	12.	16.	22.	33.	48.	66.
91.	121.	157.	191.	220.	237.	242.	237.	226.	209.
191.	174.	157.	141.	126.	113.	102.	91.	81.	72.
65.	59.	53.	47.	42.	38.	34.	32.	29.	27.
26.	24.	24.	23.	22.	21.	21.	20.	19.	19.
18.	17.	17.	16.	15.	15.	14.	14.	13.	13.
12.	12.	11.	11.	10.	10.	10.	9.	9.	8.
8.	8.	7.	7.	7.	7.	6.	6.	6.	6.

STORAGE

61.	61.	61.	61.	61.	61.	61.	61.	61.	61.
61.	61.	61.	61.	61.	61.	61.	61.	61.	61.
61.	61.	61.	61.	61.	61.	61.	61.	61.	61.
61.	61.	61.	61.	61.	61.	61.	61.	61.	61.
61.	61.	61.	61.	61.	61.	61.	61.	61.	61.
61.	61.	61.	61.	61.	61.	61.	61.	61.	61.
61.	61.	61.	61.	61.	61.	61.	61.	62.	62.
62.	62.	63.	63.	64.	64.	66.	67.	69.	72.
74.	78.	81.	84.	86.	88.	88.	88.	87.	85.
84.	82.	81.	79.	78.	77.	75.	74.	73.	72.
72.	71.	70.	69.	69.	68.	68.	67.	67.	67.
67.	66.	66.	66.	66.	66.	66.	65.	65.	65.
65.	65.	65.	64.	64.	64.	64.	64.	64.	64.
63.	63.	63.	63.	63.	63.	63.	63.	63.	63.
63.	62.	62.	62.	62.	62.	62.	62.	62.	62.

STAGE

647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0
647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0
647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0
647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0
647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0
647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0
647.0	647.0	647.0	647.0	647.0	647.0	647.1	647.1	647.1	647.1
647.1	647.2	647.2	647.2	647.3	647.3	647.4	647.6	647.8	648.0
648.2	648.5	648.7	649.0	649.2	649.3	649.4	649.3	649.2	649.1
649.0	648.9	648.7	648.6	648.5	648.4	648.3	648.2	648.1	648.0
647.9	647.9	647.8	647.8	647.7	647.6	647.6	647.6	647.6	647.5
647.5	647.5	647.5	647.5	647.5	647.4	647.4	647.4	647.4	647.4
647.4	647.4	647.3	647.3	647.3	647.3	647.3	647.3	647.3	647.3
647.2	647.2	647.2	647.2	647.2	647.2	647.2	647.2	647.2	647.2
647.2	647.2	647.2	647.1	647.1	647.1	647.1	647.1	647.1	647.1

PEAK OUTFLOW IS 242. AT TIME 43.50 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	242.	198.	85.	31.	4396.
CMS	7.	6.	2.	1.	124.
INCHES		2.55	4.37	4.73	4.73
MM		64.88	110.98	120.20	120.21
AC-FT		98.	168.	182.	182.
THOUS CU M		121.	207.	224.	224.

STATION UPDAM, PLAN 1, RATIO 2

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	1.	1.	2.	3.	4.	5.	6.
7.	8.	9.	10.	13.	17.	22.	35.	51.	69.
96.	127.	165.	201.	231.	248.	256.	246.	235.	218.
199.	181.	163.	146.	131.	117.	106.	94.	84.	75.

67.	61.	55.	49.	44.	39.	36.	33.	30.	28.
27.	25.	24.	23.	23.	22.	21.	21.	20.	19.
19.	18.	17.	17.	16.	15.	15.	14.	14.	13.
13.	12.	12.	11.	11.	10.	10.	10.	9.	9.
8.	8.	8.	8.	7.	7.	7.	6.	6.	6.

STORAGE

61.	61.	61.	61.	61.	61.	61.	61.	61.	61.
61.	61.	61.	61.	61.	61.	61.	61.	61.	61.
61.	61.	61.	61.	61.	61.	61.	61.	61.	61.
61.	61.	61.	61.	61.	61.	61.	61.	61.	61.
61.	61.	61.	61.	61.	61.	61.	61.	61.	61.
61.	61.	61.	61.	61.	61.	61.	61.	61.	61.
61.	61.	61.	61.	61.	61.	61.	61.	62.	62.
62.	62.	63.	63.	64.	65.	66.	68.	70.	72.
75.	78.	82.	85.	87.	88.	89.	88.	87.	86.
84.	83.	81.	80.	78.	77.	76.	75.	74.	73.
72.	71.	70.	70.	69.	68.	68.	67.	67.	67.
67.	67.	66.	66.	66.	66.	66.	66.	65.	65.
65.	65.	65.	65.	64.	64.	64.	64.	64.	64.
64.	63.	63.	63.	63.	63.	63.	63.	63.	63.
63.	63.	62.	62.	62.	62.	62.	62.	62.	62.

STAGE

647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0
647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0
647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0
647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0
647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0
647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0
647.0	647.0	647.0	647.0	647.0	647.0	647.1	647.1	647.1	647.1
647.1	647.2	647.2	647.2	647.3	647.3	647.5	647.6	647.8	648.0
648.2	648.5	648.8	649.1	649.3	649.4	649.4	649.4	649.3	649.2
649.1	648.9	648.8	648.7	648.5	648.4	648.3	648.2	648.1	648.0
648.0	647.9	647.8	647.8	647.7	647.7	647.6	647.6	647.6	647.5
647.5	647.5	647.5	647.5	647.5	647.5	647.4	647.4	647.4	647.4
647.4	647.4	647.4	647.3	647.3	647.3	647.3	647.3	647.3	647.3
647.3	647.2	647.2	647.2	647.2	647.2	647.2	647.2	647.2	647.2
647.2	647.2	647.2	647.2	647.1	647.1	647.1	647.1	647.1	647.1

PEAK OUTFLOW IS 256. AT TIME 43.50 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	256.	207.	88.	32.	4587.
CMS	7.	6.	2.	1.	130.
INCHES		2.67	4.56	4.94	4.94
MM		67.81	115.82	125.42	125.44
AC-FT		102.	175.	190.	190.
THOUS CU M		126.	216.	234.	234.

STATION UPDAM. PLAN 1. RATIO 3

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	1.	1.	2.	4.	6.	8.	10.	12.
14.	17.	19.	22.	29.	42.	61.	89.	124.	168.
225.	350.	488.	547.	574.	567.	537.	496.	448.	400.
355.	316.	282.	253.	237.	219.	199.	180.	162.	146.
130.	117.	105.	94.	84.	75.	68.	64.	60.	57.
54.	52.	49.	47.	45.	43.	41.	40.	38.	36.
35.	34.	32.	31.	30.	28.	27.	26.	25.	24.
24.	23.	22.	22.	21.	20.	20.	19.	18.	18.
17.	17.	16.	15.	15.	14.	14.	13.	13.	12.

STORAGE

61.	61.	61.	61.	61.	61.	61.	61.	61.	61.
61.	61.	61.	61.	61.	61.	61.	61.	61.	61.
61.	61.	61.	61.	61.	61.	61.	61.	61.	61.
61.	61.	61.	61.	61.	61.	61.	61.	61.	61.
61.	61.	61.	61.	61.	61.	61.	61.	61.	61.
61.	61.	61.	61.	61.	61.	61.	61.	61.	61.
61.	61.	61.	61.	61.	62.	62.	62.	63.	63.
64.	65.	65.	66.	67.	69.	71.	74.	78.	82.
87.	91.	93.	94.	95.	94.	94.	93.	93.	92.
91.	90.	89.	89.	88.	86.	84.	83.	81.	80.
78.	77.	76.	75.	74.	73.	72.	71.	71.	71.
70.	70.	70.	69.	69.	69.	69.	68.	68.	68.
68.	68.	67.	67.	67.	67.	67.	67.	66.	66.
66.	66.	66.	64.	66.	65.	65.	65.	65.	65.
65.	65.	64.	64.	64.	64.	64.	64.	64.	63.

STAGE

647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0
647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0
647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0
647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0
647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0
647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0
647.0	647.0	647.0	647.0	647.0	647.1	647.1	647.2	647.2	647.3
647.3	647.3	647.4	647.4	647.5	647.7	647.9	648.2	648.5	648.8
649.2	649.6	649.8	649.9	649.9	649.9	649.9	649.8	649.8	649.7
649.6	649.6	649.5	649.4	649.3	649.2	649.1	648.9	648.8	648.7
648.5	648.4	648.3	648.2	648.1	648.0	648.0	647.9	647.9	647.9
647.8	647.8	647.8	647.8	647.7	647.7	647.7	647.7	647.7	647.6
647.6	647.6	647.6	647.6	647.6	647.5	647.5	647.5	647.5	647.5
647.5	647.5	647.5	647.4	647.4	647.4	647.4	647.4	647.4	647.4
647.4	647.3	647.3	647.3	647.3	647.3	647.3	647.3	647.3	647.3

PEAK OUTFLOW IS 574. AT TIME 42.50 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	574.	444.	185.	66.	9555.
CMS	16.	13.	5.	2.	271.
INCHES		5.74	9.54	10.29	10.29
MM		145.74	242.28	261.29	261.31
AC-FT		220.	366.	395.	395.
THOUS CU M		272.	452.	487.	487.

STATION UPDAM, PLAN 1, RATIO 4

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	1.	2.	5.	8.	11.	16.	20.	24.
32.	39.	45.	54.	68.	96.	139.	200.	306.	502.
648.	823.	988.	1106.	1152.	1130.	1067.	985.	885.	787.
697.	617.	547.	484.	430.	381.	339.	301.	269.	246.
230.	211.	191.	173.	156.	141.	129.	121.	114.	109.
103.	99.	95.	91.	87.	83.	80.	77.	74.	71.
68.	66.	63.	61.	59.	57.	54.	52.	50.	48.
46.	45.	43.	41.	39.	38.	36.	35.	34.	32.
31.	30.	29.	27.	26.	25.	24.	24.	23.	23.

STORAGE

61.	61.	61.	61.	61.	61.	61.	61.	61.	61.
61.	61.	61.	61.	61.	61.	61.	61.	61.	61.
61.	61.	61.	61.	61.	61.	61.	61.	61.	61.
61.	61.	61.	61.	61.	61.	61.	61.	61.	61.
61.	61.	61.	61.	61.	61.	61.	61.	61.	61.
61.	61.	61.	61.	61.	61.	61.	61.	61.	61.
61.	61.	61.	61.	62.	62.	63.	64.	65.	66.
67.	68.	69.	70.	72.	75.	79.	85.	90.	94.
96.	98.	100.	101.	101.	101.	100.	100.	98.	97.
96.	95.	94.	93.	92.	92.	91.	90.	89.	88.
87.	85.	84.	82.	81.	79.	78.	77.	77.	76.
76.	75.	75.	74.	74.	74.	73.	73.	73.	72.
72.	72.	71.	71.	71.	71.	70.	70.	70.	69.
69.	69.	69.	69.	68.	68.	68.	68.	68.	67.
67.	67.	67.	67.	67.	67.	66.	66.	66.	66.

STAGE

647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0
647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0
647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0
647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0
647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0
647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0	647.0
647.0	647.0	647.0	647.1	647.1	647.2	647.2	647.3	647.4	647.5
647.6	647.7	647.7	647.8	648.0	648.2	648.6	649.1	649.5	649.8
650.0	650.2	650.4	650.5	650.5	650.5	650.4	650.4	650.3	650.2
650.1	650.0	649.9	649.8	649.8	649.7	649.6	649.5	649.5	649.4
649.3	649.1	649.0	648.9	648.7	648.6	648.5	648.5	648.4	648.3
648.3	648.3	648.2	648.2	648.2	648.1	648.1	648.1	648.0	648.0
648.0	648.0	647.9	647.9	647.9	647.9	647.8	647.8	647.8	647.8
647.7	647.7	647.7	647.7	647.7	647.7	647.6	647.6	647.6	647.6
647.6	647.6	647.5	647.5	647.5	647.5	647.5	647.5	647.5	647.5

PEAK OUTFLOW IS 1152. AT TIME 42.50 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1152.	903.	370.	133.	19122.
CMS	33.	26.	10.	4.	541.
INCHES		11.66	19.12	20.59	20.59
MM		296.25	485.56	522.87	522.93
AC-FT		448.	734.	790.	790.
THOUS CU M		552.	905.	975.	975.

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FORMULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO APPLIED TO FLOWS RATIO 1 0.23	RATIO 2 0.24	RATIO 3 0.50	RATIO 4 1.00
HYDROGRAPH AT	1	0.72	1	265.	277.	577.	1154.
		(0.23E 18)	(	7.52)(	7.84)(	16.34)(	32.69)(
ROUTED TO	UPDAM	0.72	1	242.	256.	574.	1152.
		(0.12E 25)	(	6.85)(	7.25)(	16.26)(	32.63)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	647.00	647.00	649.40
STORAGE	61.	61.	88.
OUTFLOW	0.	0.	247.

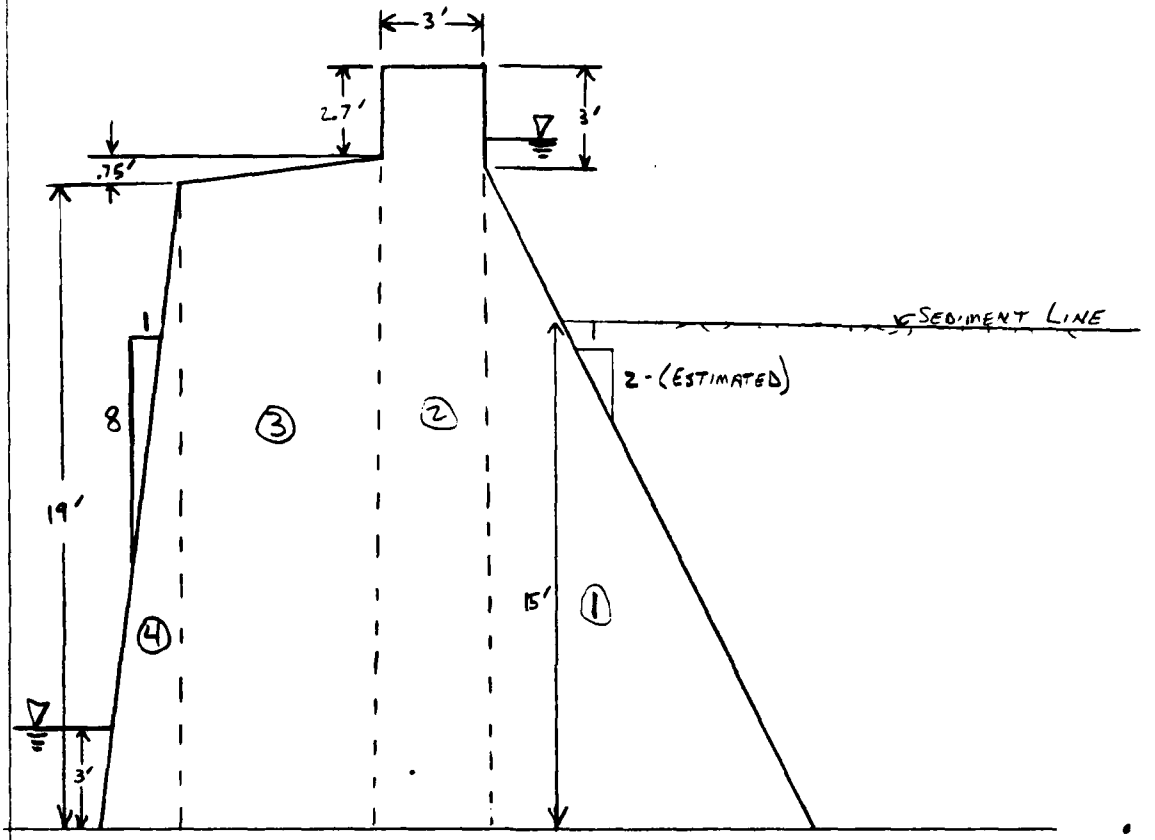
RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.23	649.56	0.	88.	242.	0.	43.50	0.
0.24	649.43	0.03	89.	256.	1.00	43.50	0.
0.50	649.94	0.54	95.	574.	6.50	42.50	0.
1.00	650.52	1.12	101.	1152.	10.50	42.50	0.

APPENDIX D

STABILITY COMPUTATIONS

COLD SPRING DAM (UPPER)	I.D. No. 107	SECTION FOR STABILITY ANALYSIS

SCALE 1" = 5'



SECTION NO.	AREA (ft^2)	DISTANCE FROM CENTROID TO TOE (FT)
①	$\frac{1}{2}(9.5)(19.5) = 92.6$	14.6
②	$(3)(22.5) = 67.5$	9.9
③	$(6)(19.4) = 116.4$	5.4
④	$\frac{1}{2}(2.4)(19) = 22.8$	1.6

STRUCTURAL STABILITY ANALYSIS

Analysis was based on approximate cross section, shown on following page, developed from measurements made at the time of inspection. A normal analysis was performed, including an overturning analysis, since the dam has a composite cross section consisting of both concrete and laid-up stone. Due to unknown foundation conditions, full uplift was assumed at the upstream toe, decreasing to the tail-water pressure at the downstream toe.

ANALYSIS CONDITIONS

1. Normal condition; water surface at spillway crest.
2. Same as #1 plus ice load of 5,000 pounds per linear foot.
3. ½PMF Flow - water surface 0.54 feet above crest of dam.
4. PMF Flow - water surface 1.1 feet above crest of dam.
5. Normal conditions with seismic coefficient of 0.1.

COLD SPRING DAM (UPPER)

STABILITY ANALYSIS PROGRAM - WORK SHEET

INPUT ENTRY		ANALYSIS CONDITION 1	2	3	4	5
Unit Weight of Dam (K/ft^3)	0	0.15	0.5	0.5	0.15	0.5
Area of Segment No. 1 (ft^2)	1	92.6	92.6	92.6	92.6	92.6
Distance from Center of Gravity of Segment No. 1 to Downstream Toe (ft)	2	14.6	14.6	14.6	14.6	14.6
Area of Segment No. 2 (ft^2)	3	67.5	67.5	67.5	67.5	67.5
Distance from Center of Gravity of Segment No. 2 to Downstream Toe (ft)	4	9.9	9.9	9.9	9.9	9.9
Area of Segment No. 3 (ft^2)	5	116.4	116.4	116.4	116.4	116.4
Distance from Center of Gravity of Segment No. 3 to Downstream Toe (ft)	6	5.4	5.4	5.4	5.4	5.4
Base Width of Dam (Total) (ft)	7	21	21	21	21	21
Height of Dam (ft)	8	22.5	22.5	22.5	22.5	22.5
Ice Loading (K/L ft.)	9	—	5.0	—	—	—
Coefficient of Sliding	10	0.55	.55	.55	.55	.55
Unit Weight of Soil (K/ft^3) (deduct 18)	11	0.055	.055	.055	.055	.055
Active Soil Coefficient - Ka	12	0.33	0.33	0.33	0.33	0.33
Passive Soil Coefficient - Kp	13	3.0	3.0	3.0	3.0	3.0
Height of Water over Top of Dam or Spillway (ft)	14	—	—	3.04	3.60	—
Height of Soil for Active Pressure (ft)	15	15	15	15	15	15
Height of Soil for Passive Pressure (ft)	16	—	—	—	—	—
Height of Water in Tailrace Channel (ft)	17	3	3	5.5	5.5	3
Weight of Water (K/ft^3)	18	0.0624	.0624	.0624	.0624	.0624
Area of Segment No. 4 (ft^2)	19	22.8	22.8	22.8	22.8	22.8
Distance from Center of Gravity of Segment No. 4 to Downstream Toe (ft)	20	1.6	1.6	1.6	1.6	1.6
Height of Ice Load or Active Water (ft) (does not include 14)	46	20	20	20	20	20
Seismic Coefficient (g)	50	—	—	—	—	0.1
RESULTS OF ANALYSIS						
Factor of Safety vs. Overturning		1.39	1.03	1.16	1.13	1.33
Distance From Toe to Resultant		3.77	.42	1.93	1.62	3.38
Factor of Safety vs. Sliding		1.15	0.85	0.88	0.84	0.82

ADD 2.5' DURING FLOOD CONDITIONS, ASSUMING WATER GOES TO TOP OF LOWER DAM

APPENDIX E

REFERENCES

APPENDIX E

REFERENCES

1) U.S. Department of Commerce; Weather Bureau; Hydrometeorological Report No. 33 - Seasonal Variation of the Probable Maximum Precipitation East of the 105th Meridian for Areas from 10 to 1,000 Square Miles and Durations of 6, 12, 24, and 48 hours, April 1956.

2) H.W. King and E.F. Brater, Handbook of Hydraulics, 5th edition, McGraw-Hill, 1963.

3) University of the State of New York, Geology of New York, Education Leaflet 20, Reprinted 1973.

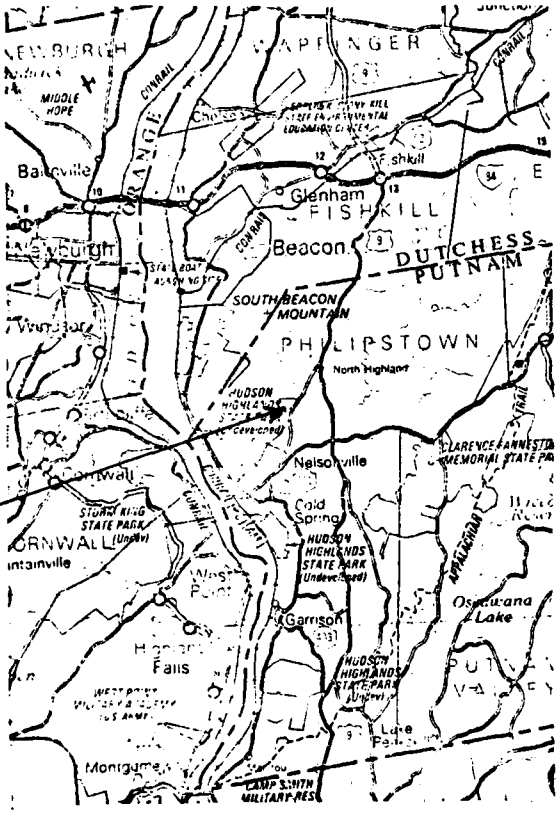
4) Elwyn E. Seelye, Design, 3rd edition, John Wiley and Sons, Inc. 1960.

5) U.S. Department of the Interior, Bureau of Reclamation ; Design of Small Dams, 2nd edition (rev. reprint), 1977.

6) T.S. George and R.S. Taylor; Lower Hudson River Basin Hydrologic Flood Routing Model; Department of the Army, New York District Corps of Engineers; Water Resources Engineers, Inc. January, 1977.

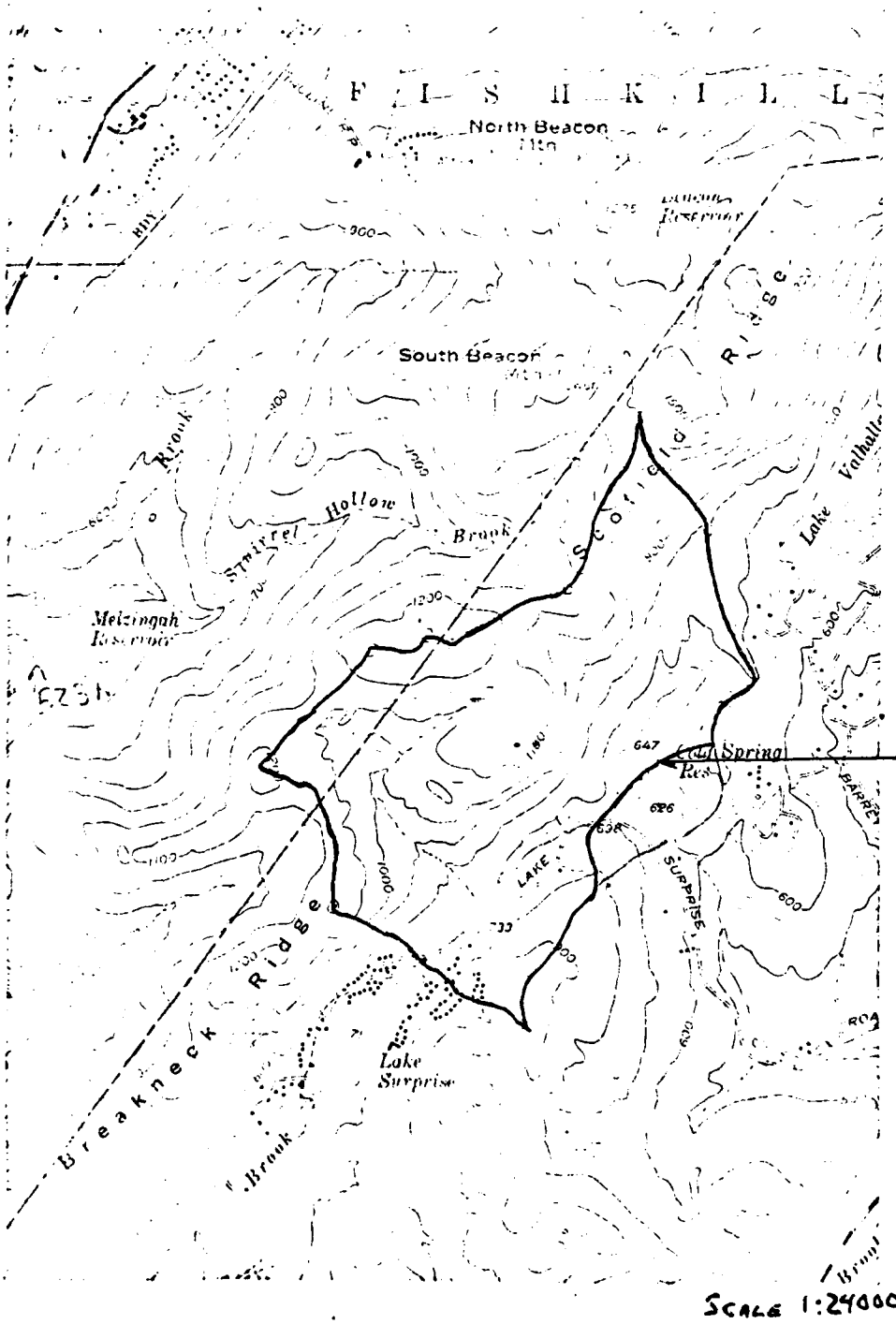
APPENDIX F

DRAWINGS



VICINITY MAP
COLD SPRING DAM (UPPER)

I.D.NO. NY-106



TOPOGRAPHIC MAP
COLD SPRING DAM (UPPER)

I.D. NO. NY-106

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